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SHORT REPORT

Calculating the carbon footprint of a Geriatric Medicine clinic before and after COVID-19

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Abstract

Background: climate change is a health emergency. Central to addressing this is understanding the carbon footprint of our daily life and work, in order to reduce it effectively. The coronavirus disease of 2019 (COVID-19) pandemic has brought about rapid change to clinical practice, most notably in use of virtual clinics and personal protective equipment (PPE).
Aim: to estimate the carbon footprint of a Geriatric Medicine clinic, including the effect of virtual consultation and PPE, in order to inform design of a service that addresses both the health of our patients and our environment.
Method: data from the Greenhouse Gas Protocol, NHS Carbon Footprint Plus and UK Government were used to estimate the carbon emissions per consultation. Values were calculated for virtual and face-to-face contact and applied to actual clinics both before and during the COVID-19 pandemic.
Results: the carbon footprint of a face-to-face clinic consultation is 4.82 kgCO_2e, most of which is patient travel, followed by staff travel and use of PPE. The footprint of a virtual consultation is 0.99 kgCO_2e, most of which is staff travel, followed by data use. Using our hybrid model for a single session clinic reduced our annual carbon footprint by an estimated 200 kgCO_2e, roughly equivalent to a surgical operation.
Discussion: the COVID-19 pandemic has made us deliver services differently. The environmental benefits seen of moving to a partially virtual clinic highlight the importance of thinking beyond reverting to ‘business as usual’—instead deliberately retaining changes, which benefit the current and future health of our community.

Keywords: carbon, emissions, telemedicine, clinic, COVID-19, older people

Key Points

- Virtual clinics reduce carbon footprint.
- Carbon emissions contribute to climate change and population health.
- We have a duty of care to reduce our carbon footprint.
- PPE has a carbon footprint.
- COVID-19 changes to carbon footprint of Geriatric Outpatients

Introduction

Of the UK’s annual 450 million tonnes of carbon dioxide equivalent emissions (CO_2e; [1]), the NHS is responsible for 5% (25 million tonnes; [2]), 10% of which is patient travel [2]. Carbon emissions harm respiratory, cardiovascular and cerebrovascular health and contribute to climate change [3–6]. We must take responsibility for reducing our environmental impact [3].

In 2020, to mitigate the danger of coronavirus disease of 2019 (COVID-19), we changed our traditional outpatient model to a combination of face-to-face, video and telephone consultations.

A 2021 review found 14 studies (mostly pre-pandemic) demonstrating the carbon savings of telemedicine across different specialties [7].

A 2018 economic scoping study by NHS Midlands and Lancashire estimated that making 15% of hospital follow-ups virtual would save 53,000 $kgCO_2e$/year by reducing transport use [8].

However, virtual consultation is not carbon neutral as energy is required for data storage and transfer [9]: teleconferencing is only carbon cost-effective if the patient journey is over 7.2 km (4.5 miles; [10]).

In contrast to earlier studies, personal protective equipment (PPE) is now used during all face-to-face encounters. This requires manufacture and disposal: during the first 6 months of the pandemic, PPE was responsible for 106,000 tonnes CO_2e in England [11].

We have explored the carbon footprint of an outpatient clinic in our Geriatric Medicine department, before and after onset of the COVID-19 pandemic. To our knowledge, this is the first calculation of the carbon footprint of outpatient geriatric medicine, and is the first real world study analysing the effect of all COVID-19 related changes on the outpatient carbon footprint.

Method

We calculated the footprint of a single afternoon clinic for a 3-month period before COVID-19 and for a similar period once virtual consultation and PPE were established. We included patient travel, staff travel, PPE, water, waste, telecommunications and heating/lighting the clinic facilities. We have not included embedded carbon in pre-existing vehicles or computer hardware or emissions related to investigations requested or secretarial work—our assumption is that these remain unchanged regardless of COVID-19 adaptations.

The Greenhouse Gas Protocol divides carbon footprints into three 'Scopes' [12]. Scope 1 is direct emissions from the activity—e.g. release of anaesthetic gases. There are no Scope 1 emissions associated with outpatient work. Scope 2 emissions encompass the carbon footprint of national grid energy consumed and Scope 3 includes emissions generated in manufacture of materials used, waste management, commuting or goods transport. Consumer travel is not included in the Greenhouse Gas Protocol but is included in the vision for 'Net Zero Plus' by the NHS England Sustainability Development Unit [5, 12].

Patient travel

We have assumed that journeys were undertaken in average sized petrol cars with two occupants, as the likelihood of our patient group being too frail to walk or take the bus was high. We used Google Maps™ to calculate the mileage between home postcode and our clinic, and the Department for Environment, Food and Rural Affairs (DEFRA) published values for petrol emissions per mile [13].

Scope 2

Scope 2 emissions (national grid energy consumption) intrinsic to running the clinic were calculated assuming the following parameters: an average of four patients are seen by three members of staff (doctor, nurse and healthcare assistant) using space within the hospital equivalent to a small house (an office, nurses room, waiting room and two clinic rooms with corridors and a toilet). Two computers are required, and PPE is worn in post COVID-19 clinics. There is a television in the waiting room. Virtual consultations occur in the same clinic facilities, between face-to-face appointments. The nurse and healthcare assistant are not required and only one computer is necessary. Most virtual consultations were by landline telephone rather than internet video call. The annual household electricity consumption values published by The UK household Electricity Survey [14] were scaled to an equivalent value to obtain an estimate of electricity consumed per consultation.

Scope 3

Emissions from manufacture, transport and disposal of PPE were calculated using values published for PPE use in the UK by Rizan *et al*. [11]. Domestic waste and waste water disposal related emissions were calculated using data published by DEFRA [13]. DEFRA also publish the emissions generated from consumption of clean water [13]. Emissions from telecommunications have been calculated by Ong *et al*. [16]. We assumed a 4 mile car commute per staff member.

Results

Fewer patients were seen face-to-face following the implementation of social distancing measures. Appropriate PPE was used for those that were. Even including the carbon emission of this, the overall carbon footprint for the mixed consultation clinic was reduced from 72.1 to 55.34 kgCO2e driven primarily by reduced emissions from patient travel (Table 1).

Performing an hour-long consultation virtually created 0.994 kgCO2e per consultation compared to 4.824 kgCO2e for face-to-face (Table 2). A detailed breakdown of carbon emissions from a fully virtual model clinic (Table A) compared to a fully face-to-face clinic (Table B) can be found in supplementary data.

Breakdown of emissions

Patient travel

The average UK petrol car emits 0.28 $kgCO_2e$/mile [13], and our patients travelled an average of five miles to our clinic emitting 2.88 $kgCO_2e$ for a round trip. Around 54% of consultations were virtual post COVID-19, avoiding 251 miles travel (70.45 $kgCO_2e$) over 3 months. This saving was offset by increased use of telemedicine and PPE, so the

Table 1. Comparison of clinic-generated carbon emissions pre- and post-social distancing measures due to COVID-19

	Before social distancing	After social distancing
Total number patients in 3 months	48	39
Patients per month	16	13
Patients consulted over phone	0	7
Patients seen in person per month	16	6
Mean distance between residence and clinic (miles)	4.7	5.6
Carbon emissions from patient travel per month (kgCO2e)	42.37	24.3
Carbon emissions from clinic overheads (kgCO2e)	29.73	31.04
Total emissions per month (kgCO2e)	72.1	55.34
Emissions per consultation (kgCO2e)	4.51	4.26

Table 2. Comparison of clinic-generated carbon emissions for face-to-face and virtual consultation (kgCO2e)

	Face-to-face	Virtual
Energy use for rooms	0.065	0.065
Telecommunications	0.039	0.369
Personal protective equipment	0.152	0
Water use	0.008	0
Staff travel	1.68	0.56
Patient travel	2.88	0
Total emissions per consultation	**4.824**	**0.994**

average emission per consultation during the pandemic was 0.25 $kgCO_2e$ less than pre-pandemic.

Scope 2

National Grid energy consumption emits 0.233 $kgCO_2e$ per kilowatt hour [13]. The energy consumption used running the clinic was 0.259 $kgCO_2e$, equating to a value per consultation of 0.065 $kgCO_2e$.

Scope 3

Personal Protective Equipment: one member of staff wears one type IIR surgical facemask per clinic (sessional use), and one pair of nitrile gloves with one plastic apron per patient. One apron emits 65 gCO_2e, a facemask 20 gCO_2e and a pair of gloves 52 gCO_2e (11). Per consultation this equates to 0.15 $kgCO_2e$, including disposal.

Water and Waste: one clinic generates 250-g domestic waste (paper towels), equal to 85 gCO_2e [13]. One 20-s hand wash uses 1.75-l water. For four patients, hands should be washed four times plus at the beginning and end of the clinic: 31.5-l of water is required per clinic. Clean water consumption emits 0.34 $kgCO_2e/m^3$ and wastewater treatment 0.7 $kgCO_2e/m^3$ [13]. Per consultation this equates to 8 gCO_2e.

Telecommunications

Telecommunications: a video call of adequate quality to hear and examine a patient requires a bandwidth of 5.5 megabits per second [15, 16] and emits 2.95 $kgCO_2e$ per hour [13]. Landline transmission energy data were not available but the energy required for the handset emits 0.7 gCO_2e per hour.

Discussion

This small project relies on assumptions and extrapolations but provides an estimate of clinic-generated carbon emissions and a basis from which to develop carbon reduction strategies.

The carbon emissions of an outpatient consultation are small compared with that of an operation [17] or a flight [13] but over the course of a year the emissions add up. By moving to a hybrid model for our weekly clinic we have saved over 200 $kgCO_2e$.

The biggest contributor to carbon emissions from an outpatient clinic is travel, followed by PPE use and then telecommunications. Water, lighting and heating contribute relatively little.

If clinics were 100% virtual, we would save several hundred kilograms of carbon equivalent emissions. However, there is a clinical need to see patients face-to-face and there would be consequences of failing to do so. Escalating illness and healthcare intervention in consequence of a delayed or missed diagnosis could have a greater carbon cost than timely intervention.

For those consultations that need to be face-to-face, changing mode of travel would have the greatest impact on emissions. Staff should be encouraged to use green forms of transport but patient travel is unlikely to be influenced by carbon concerns. Many attendees will be frail or disabled and will not manage public transport, walking or cycling. Emissions would be reduced using electric vehicles for patient transport, in line with the NHS Sustainable Development Unit vision [5].

Using hand washing alone instead of gloves could reduce PPE emissions by 45% [8]. An hour video call is comparable to a 10 mile journey in a car. A lower bandwidth uses less carbon, but the definition needs to be clear enough to have a meaningful interaction Using telephone for follow-up appointments, unless repeat examination is needed, may be a better option.

Finally, although climate initiatives benefit patient satisfaction and cost-effectiveness [18], it can be hard for clinicians to engage in climate concern when they are already under pressure from conflicting interests and demands. Nevertheless, we believe that promoting successful small interventions can inspire hope and motivation in staff who might otherwise perceive it as a problem beyond their capacity.

Supplementary Data: Supplementary data mentioned in the text are available to subscribers in *Age and Ageing* online.

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